

REMARKS/ARGUMENTS

Claims 16, 19-28, 30, 31 and 34-42 are pending in this application. By this Amendment, claims 16, 20, 22, 24, 25, 30, 37, 39 and 40 are amended. Reconsideration in view of the above amendments and the following remarks is respectfully requested.

Unless otherwise indicated in the remarks set forth below, the amendments to the claims are made for the purpose of correcting informalities and/or to more clearly define the claimed invention, and are not made for the purpose of overcoming the cited art.

The Patent Office objects to the drawings under 37 C.F.R. 1.83(a). Specifically, the Patent Office claims that “the optical waveguide comprises a plurality of light guiding cores,” recited in claim 28 are not shown in the drawings. Applicant respectfully refers the Patent Office to Figs. 5 and 6, as well as the corresponding discussion on page 10, paragraphs 51-54. Thus, Applicant respectfully submits that the drawings show the feature of an optical waveguide comprising a plurality of light guiding cores. Accordingly, withdrawal of the objection is respectfully requested.

The Office Action rejects claims 16, 19-28, 30-31 and 34-42 under 35 U.S.C. § 112, first paragraph as based on a disclosure which is not enabling. This rejection is respectfully traversed.

The Patent Office alleges that the “*conditions* of having the refractive index of the liquid crystal holographic optical element to be **greater** than the refractive index of the waveguide and the light incident on the liquid crystal holographic optical element must be **greater** than a *critical*

angle in order for the light to be reflected back to the optical waveguide the *total internal reflection* are critical or essential to the practice of the invention, but not included in the claim(s) is not enabled by the disclosure" (emphasis in original). Thus, the Patent Office concludes that claims 16, 19-28, 30-31 and 34-42 are not enabled by the disclosure.

Applicant respectfully submits that what is required under 35 U.S.C. § 112, first paragraph is that the features that are critical or essential to the practice of the invention be included in the claims. Applicant respectfully submits that the features that are critical or essential to the practice of the invention are recited in the claims. Once the critical features are recited, the physical conditions that must be present are, by definition, inherent. As the Patent Office correctly points out, the conditions of having the refractive index of the liquid crystal holographic optical element be greater than the refractive index of the waveguide and the condition of the light incident on the liquid crystal holographic optical element makes an angle greater than a critical angle are necessary criterions for total internal refraction to occur. Thus, these conditions inherently arise by reciting the feature that the refractive index of the holographic optical element is such that substantially all of the input light is reflected back to the optical waveguide via total internal reflection.

However, in order to expedite prosecution, claims 16 and 30 have been amended to recite that "the liquid crystal holographic optical element is selectively adjustable, based on a voltage applied across the liquid crystal holographic optical element by the first and second sets

of electrodes, between a first state, in which a refractive index of the liquid crystal holographic optical element and an angle of incidence of the input light are such that substantially all of the input light is reflected back to the optical waveguide via total internal reflection, and at least one other state, in which at least one hologram is formed in the liquid crystal holographic optical element such that a refractive index of the liquid crystal holographic optical element and an angle of incidence of the input light do not satisfy total internal reflection criterions, thereby causing at least some of the input light to enter and be diffracted by the liquid crystal holographic optical element.

Accordingly, Applicant respectfully submits that the claims are properly enabled. Thus, withdrawal of the rejection under 35 U.S.C. § 112, first paragraph, is respectfully requested.

The Office Action rejects claim 16, 19-28, 30-31 and 34-42 are objected to for informalities. Specifically, the Patent Office alleges that the phrase “the liquid crystal holographic optical element comprises at least one hologram that is *selectively adjustable*” (emphasis in original) recited in claims 16 and 30 is confusing and indefinite because it is not clear what the physical results of the “selected adjustment” of the hologram are. Claims 16 and 30 have been amended to clarify that the liquid crystal holographic optical element “is selectively adjustable, based on a voltage applied to the liquid crystal holographic optical element by the first and second set of electrodes, between a first state, in which a refractive index of the liquid crystal holographic optical element and an angle of incidence of the input light are such that

substantially all of the input light is reflected back to the optical waveguide via total internal reflection, and at least one other state, in which at least one hologram is formed in the liquid crystal holographic optical element such that a refractive index of the liquid crystal holographic optical element and an angle of incidence of the input light do not satisfy total internal reflection criterions, thereby causing at least some of the input light to enter and be diffracted by the liquid crystal holographic optical element.” Accordingly, Applicant respectfully submits that the function of the “liquid crystal holographic optical element” is clear.

The Patent Office also alleges that the phrase “a plurality of light guiding cores” in claim 28 is confusing and indefinite because it is not clear how the “plurality of light guiding cores” relate to the liquid crystal holographic optical element. Claim 16, from which claim 28 depends, recites, *inter alia*, “an optical waveguide, comprising at least one light guiding core.” Further, claim 16 recites a first set of electrodes positioned on the at least one light guiding core and a liquid crystal holographic optical element positioned on the first set of electrodes. Thus, claim 16 clearly recites how these elements relate to one another.

Further, claim 28 simply recites that the optical waveguide comprises a plurality of light guiding cores. On the plurality of light guiding cores, a first set of electrodes is positioned, and a liquid crystal holographic optical element is positioned on the first set of electrodes. Thus, it is clear how these elements relate to one another. Applicant also refers the Patent Office to Figs. 5 and 6, and the associated discussion in the specification on page 10, paragraphs 51-54, which

clearly explain how these elements relate to each other, and how the plurality of light guiding cores are arranged substantially parallel to the first or second set of electrodes.

The Patent Office also alleges that the phrase “an index of refraction of the liquid crystal holographic optical element in the first state is substantially the same as the index of refraction of the at least one cladding layer” recited in claim 31 is confusing an indefinite because it is not clear how these features have anything to do with the device. Applicant refers the Patent Office to page 15, paragraph 88 to page 16, paragraph 90 of the specification, which explains how in one state of the hologram pattern (obtained when a voltage is applied to the liquid crystal 26), the liquid crystal molecules of the liquid crystal 26 are arranged to have a constant refractive index which is the same as the refractive index of the cladding 23. Because the refractive index of the liquid crystal molecules of the liquid crystal 26 is the same as that of the cladding 23, the liquid crystal molecules of the liquid crystal 26 will also function in a manner similar to the cladding 23, i.e., it will totally internally reflect light back to the core of the optical waveguide. Accordingly, Applicant respectfully submits that claim 31, when properly read in view of the specification, recites a feature that is clearly related to the functioning of the device.

Accordingly, for at least the reasons set forth above, withdrawal of the objection to claims 16, 19-28, 30-31 and 34-42 is respectfully requested.

The Office Action rejects claims 16 and 23-27 under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 5,452,385 to Izumi et al. (hereinafter “Izumi”). This rejection is respectfully traversed.

Izumi fails to disclose every claimed feature, as required under 35 U.S.C. § 102. The Patent Office alleges that Izumi teaches a display device that is comprised of a light guide medium that serves as a light guiding core for an optical waveguide, for receiving and guiding light, a set of first electrodes (43a-43d) positioned on the waveguide, a liquid crystal medium (42) incorporated with a holographic diffraction grating (44), that together serve as the liquid crystal holographic optical element, positioned on the first set of electrodes and a second set of electrodes (45) positioned on the liquid crystal holographic optical element. However, Applicant respectfully submits that Izumi does not teach the use of a liquid crystal holographic optical element. Rather, Izumi teaches the use of a liquid crystal 42 positioned on top of a separate set of diffraction gratings 44. Izumi teaches that the set of diffraction gratings are formed in a photosensitive resin 49 (see col. 8, lines 10-23).

In contrast, claim 16 recites that “the liquid crystal holographic optical element is selectively adjustable based on a voltage applied across the liquid crystal holographic optical element by the first and second sets of electrodes, between a first state . . . and at least one other state, in which at least one hologram is formed in the liquid crystal holographic optical element such that a refractive index of the liquid crystal holographic optical element and an angle of

incidence of the input light do not satisfy total internal reflection criterions, thereby causing at least some of the input light to enter and be diffracted by the liquid crystal holographic optical element.” Thus, the hologram is formed in the liquid crystal holographic optical element in one state of the liquid crystal holographic optical element, rather than the static set of diffraction gratings formed on a photosensitive resin taught by Izumi.

Thus, Applicant respectfully submits that Izumi fails to anticipate the subject matter of claim 16. Claims 23-27 depend from claim 16, and are thus also allowable for at least the reasons discussed above, as well as for the additional features they recite. Accordingly, withdrawal of the rejection under 35 U.S.C. § 102(b) is respectfully requested.

The Office Action rejects claim 28 under 35 U.S.C. § 103(a) as unpatentable over Izumi. Claim 28 depends from claim 16. Thus, for at least the reasons set forth above, Applicant respectfully submits that Izumi fails to render obvious the subject matter of claim 28. Accordingly, withdrawal of the rejection of claim 28 under 35 U.S.C. § 103(a) is respectfully requested.

The Office Action rejects claims 30-31 and 38-42 under 35 U.S.C. § 103(a) over Izumi in view of U.S. Patent No. 5,106,181 to Rockwell et al. (hereinafter “Rockwell”). This rejection is respectfully traversed.

As discussed above, Izumi teaches the use of a separate set of diffraction gratings (44) that are formed on a photosensitive resin (49), on which a separate liquid crystal layer (42) is

placed. In contrast, claim 30 recites that “the liquid crystal holographic optical element is selectively adjustable, based on a voltage applied across the liquid crystal holographic optical element by the first and second sets of electrodes, between a first state . . . and at least one other state, in which at least one hologram is formed in the liquid crystal holographic optical element such that a refractive index of the liquid crystal holographic optical element and an angle of incidence of the input light do not satisfy total internal reflection criterions, thereby causing at least some of the input light to enter and be diffracted by the liquid crystal holographic optical element.”

Accordingly, Applicant respectfully submits that Izumi fails to teach or suggest these features. Further, Rockwell fails to remedy the deficiencies noted above in Izumi.

Thus, for at least the reasons set forth above, Applicant respectfully submits that Izumi and Rockwell fail to render obvious the subject matter of claim 30. Claims 31 and 38-42 depend from claim 30, and are thus also allowable as depending from allowable claim 30, as well as for the additional features they recite. Accordingly, withdrawal of the rejection of claims 30, 31 and 38-42 under 35 U.S.C. § 103(a) is respectfully requested.

The Office Action rejects claims 16 and 19-28 under 35 U.S.C. § 103(a) over U.S. Patent No. 6,646,636 to Popovich et al. (hereinafter “Popovich”) in view of U.S. Patent No. 6,821,457 to Natarajan et al. (hereinafter “Natarajan”). This rejection is respectfully traversed.

The Patent Office alleges that Popovich teaches a display device having a light guide (24) that serves as the light guiding core of an optical wave guide for receiving and guiding light having a first set of electrodes (40) formed on the waveguide and a liquid crystal holographic optical element (32) positioned on the first set of electrodes, and a second set of electrodes (40) positioned on the liquid crystal holographic optical element, such that the first and second sets of the electrode defines pixel areas for the display device. However, Applicant respectfully submits that the first and second set of electrodes (40) do not define pixel areas of the display device. Rather, these sets of electrodes are used to switch the entire holographic optical element (32) in order to switch the illumination light source. The pixel areas in the display system of Popovich are defined by a separate display device 28, which Popovich indicates can comprise a liquid crystal display panel. The display device 28 has its own set of electrodes that define a pixel array for the display device.

The electrodes referred to by the Patent Office (40) are used to switch the holographic optical elements (32, 34) between a diffracting state and a non-diffracting state in order to direct illumination light either towards the display device 28 or away from the display device 28. Thus, the electrodes (40) do not control the direction of light on a pixel-by-pixel basis.

In contrast, claim 16 recites a first set of electrodes positioned on the optical waveguide, a liquid crystal holographic optical element positioned on the first set of electrodes, and a second set of electrodes positioned on the liquid crystal holographic optical element, wherein the at least

first and second sets of electrodes define pixel areas of the display device and are adapted to selectively apply a voltage across one or more pixel areas of the liquid crystal holographic optical element.

Further, Natarajan fails to remedy the deficiencies noted above in Popovich. Natarajan discloses an electrically switchable liquid crystal material and optical couplers and reconfigurable optical interconnects using the electrically switchable liquid crystal materials. Thus, Natarajan does not teach or suggest a display device that comprises first and second sets of electrodes that define pixel areas of the display device and are adapted to selectively apply a voltage across one or more pixel areas of the liquid crystal holographic optical element.

Thus, for at least the reasons set forth above, Applicant respectfully submits that Popovich and Natarajan fail to render obvious the subject matter of claim 16. Claims 19-28 depend from claim 16, and are thus also allowable for at least the reasons set forth above, as well as for the additional features they recite. Accordingly, withdrawal of the rejection of claims 16 and 19-28 under 35 U.S.C. § 103(a) is respectfully requested.

The Office Action rejects claims 30-31 and 34-42 under 35 U.S.C. § 103(a) over Popovich in view of Natarajan and Rockwell. This rejection is respectfully traversed.

Claim 30 recites, *inter alia*, a display device that comprises first and second set of electrodes that together define pixel areas of the display device and that adapted to selectively supply a voltage across one or more pixel areas of the liquid crystal holographic optical element.

As discussed above, Popovich and Natarajan fail to teach or suggest these features, because Popovich does not pixelize the holographic optical element used in his display device, and because Natarajan is not even directed to a display device. Further, Rockwell fails to remedy the deficiencies noted above in Popovich and Natarajan.

Thus, for at least the reasons set forth above, Applicant respectfully submits that Popovich, Natarajan, and Rockwell fail to render obvious the subject matter of claim 30. Claims 31 and 34-42 depend from claim 30, and are thus also allowable for at least the reasons set forth above, as well as for the additional features they recite. Accordingly, withdrawal of the rejection of claims 30, 31 and 34-42 is respectfully requested.

CONCLUSION

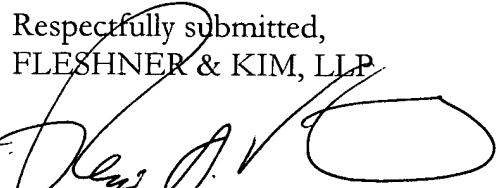
In view of the foregoing amendments and remarks, it is respectfully submitted that this application is in condition for allowance. Favorable consideration and prompt allowance are earnestly solicited. If the Examiner believes that any additional changes would place the application in better condition for allowance, the Examiner is invited to contact the undersigned attorney, René A. Vázquez, Esq., at the telephone number listed below.

Serial No. **10/662,316**
Reply to Office Action of **March 29, 2005**

Docket No. **K-0541**

To the extent necessary, a petition for an extension of time under 37 C.F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this, concurrent and future replies, including extension of time fees, to Deposit Account 16-0607 and please credit any excess fees to such deposit account.

Respectfully submitted,
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